THE TELEGRAPHIC JOURNAL.
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THE CAPE CABLE.

THE question of telegraphic communication between England and the Cape of Good Hope seems now to be taken up in earnest by the Imperial Government, and by the Colonies concerned. It is even reported that arrangements are being made for extending the system of land lines in the Orange Free State, so as to meet the coast at the point where the South African Cable will ultimately be landed. We are glad to hear of this revival of activity in submarine cable laying, and hope soon to hear of the arrangements for the projected scheme being complete, and the work proceeding.

The proposal for a cable to the Cape was first seriously entertained in 1873, when agents of three different telegraph companies were sent out to discuss the matter with the local Cape governments. The result was a contract with Messrs. Hooper and Co. to complete a cable from Aden to the Cape by December 31st, 1875. Early in 1875, however, Messrs. Hooper, who had begun the manufacture of the cable, requested more favourable terms, and the former contract became nullified altogether. Last year the subject was again mooted by Mr. John Pender, who advocated a cable from Aden to Natal, with a branch to Mauritius, while Mr. Donald Currie supported the general object, but favoured a west coast route, *via* the Island of St. Vincent. It is well understood that an east coast cable would be advantageous to the Eastern Telegraph Company, with which Mr. Pender is connected, and that a west coast cable would, to some extent, benefit the shipping interest associated with Mr. Currie, and therefore their advocacy of these opposite routes is natural enough. But, of course, these gentlemen were wise enough to know that the question of routes must eventually be decided in the interests of the Colonies themselves. Everything considered, we think that Mr. Pender's route is the most advantageous to the latter, and fortunately, if adopted, it will also prove advantageous to existing telegraph systems.

Mr. Pender's modified scheme is to connect Aden to Zanzibar, Mozambique, and Natal, by cables, and Natal to Cape Town by land-lines. To effect this, some 4,000 miles of cable will be required. The lowest price at which the Telegraphic Construction and Maintenance Company can make and lay this length within nine months after date of contract is stated by him to be £900,000, or at the rate of £225 per mile. The cost of a repairing ship and her equipment would add to this sum another £50,000, making a first outlay of £950,000 in all. This amount would be raised by the Imperial Government at an annual interest of, say £33,000. The Eastern Company are, we understand, prepared to work the line for £7,000 yearly, and to allow a rebate of 15 per cent. from their ordinary tariff for all messages sent over their system, a concession which would amount annually to about £13,000. To the interest on cost of construction, £33,000, plus this £7,000 for working expenses, must be added £10,000 for the maintenance of a repairing ship, and £19,000 for the formation of a sinking fund to renew the cable on an average every 20 years, making a yearly total of £69,000. From this amount will have to be deducted the annual receipts of the line, which Mr. Pender estimates at £33,000 at a tariff of 5s. per word from South Africa to Aden, and the £13,000 for rebate, leaving a balance of £23,000 to be made up by subsidies from the Cape Colonies, the Sultan of Zanzibar, and the Portuguese Government, who have offered £2,500 a year if the cable be landed at Delagoa Bay, and £5,000 a year if it be also landed at Mozambique.

If it is decided to carry out the branch to Mauritius (and the colonists there appear to be anxious to have it), an additional 1,500 or 1,600 miles of cable will be necessary. In this case the total capital required will be over £1,300,000. The interest and other expenses will be increased accordingly, but it may be shewn that the total deficit will exceed the deficit in the former case only by two or three thousand pounds, which can be raised by subsidy from Mauritius.

After the Cape cable *via* Aden with a branch to Mauritius is working successfully, we shall doubtless soon hear of another scheme to connect Mauritius with Ceylon.

"EDISON'S THUNDER STOLEN."

WE are glad to see that the discovery of the microphone by Prof. Hughes is beginning to be regarded in its proper light by the scientific journals of America, and as these are the only journals competent to consider the matter, and the only ones which should have been allowed to do so, all the deluge of newspaper articles which have been written on the subject may be ignored as so much waste paper. The European mail, which brought a full account of Mr. Preece's lecture before the Society of Telegraph Engineers, has enabled American scientists to understand the real nature of the microphone, and to discern the distinction between it and the Edison Carbon Telephone. Mr.

Edison, however, continues his rash and reckless assertions in the public press. "Edison's Thunder Stolen!" is the "violent" heading of a long article in the *New York Sun* of June 9, relating an interview with the inventor immediately on receipt of the mails with Mr. Preece's lecture.

We have tried to discover the connection between the heading of this article and the subject in question, but without avail, unless, indeed, we are to suppose that Mr. Edison has a proprietary right in the fires of heaven, having taken over the business of Jupiter. The carbon telephone, on this supposition, might appropriately be regarded as one of the thunderbolts of the effete god. If this be so, woe to the luckless inventor who shall wittingly or unwittingly trespass on Mr. Edison's triple-guarded patents. If any man should by any possibility re-discover symptoms of that marvellous "Etheric Force" which has so mysteriously disappeared from creation, Mr. Edison will summon around him the minions of the Press, and startle the world with the terrible announcement that Edison's Cosmos is Plundered!

In the article in the *New York Sun*, we are told that a "*Sun* reporter showed Mr. Edison the accounts in the London papers quoted above, and asked, 'What do you say to that?'

"The inventor stood in the doorway of his laboratory, dressed in his working costume, and wearing his historic slouched hat. His hands were still grimy from contact with the tools and machinery of the workshop. He glanced rapidly over the articles. His first exclamation was:

"'Phew!'

"Then he read a little further, and ejaculated:

"'Well!'

"At length, as he finished the perusal, he said, with his most comical of expressions, and with a twinkle of humour in his eyes: 'I declare that is the coolest, cleanest steal that I ever knew.'" We refrain from repeating the rest.

Mr. Edison then proceeded to support his case by a course of argument, backed by quotations, which appears to us to be speciously misleading.

It is not our intention to follow him all through it, but we give the following sample of his method:

"Did you show him (Mr. Preece) the microphone," asked the reporter.

"Why, of course I did, because the microphone is contained in the telephone. To say that the microphone is a superior invention to the telephone is absurd, because it is only a part of the telephone. There would be no use in adjusting a telephone to such a delicate pitch, because the jar of a building, the hum and roar of the city, would keep up a continual buz. Hence it could not be a practical articulating telephone." This extract speaks sufficiently well for itself. Mr. Edison did not invent the microphone because he considered it a nuisance!

"The hour for the reporter to leave came all too soon," continues the article, "and as he went from the laboratory he heard Mr. Edison saying to his associate, Mr. Batchelor, 'Let 'em (the English) steal the microphone if they will; that is only a little thing. Before another two years go by, I'll give 'em phones and graphs enough to make 'em sick.'" To make the whole British nation sick! That would indeed be a pull upon John Bull which would convulse Jonathan with delight. And Mr. Edison, if he can do this, if he can make the whole British nation sick, will earn for himself a fame far beyond that of Washington or Columbus, a fame which will be sung by Yankee poets, and spouted by phonographs and strong minded females till the end of time.

We never read these personal articles on the microphone in American newspapers without a feeling akin to disgust which we cannot repress—a feeling which is only tempered by pity for the poor reporters, who have to attend upon a piqued inventor and make a note of the condition of his "historic hat," or chronicle his interesting "Phew." We protest in the name of science and good taste against the majority of these articles. If Mr. Edison thinks he is establishing his claim to the invention of the microphone by charging the newspapers with rubbish he is egregiously mistaken. We regret to say it, but it is too true, that he is only thereby tarnishing his own splendid reputation, and making a laughing stock of himself. In the fevered atmosphere of American journalism such a procedure may pass unchallenged; but in Europe it is regarded with decided disapproval. We hope that Mr. Edison in future will be truer to himself, and that he will continue to astonish his age, rather by the fruits of his mechanical genius, than by his dealings with the newspaper press. For what are great achievements if they do not win respect?

CORDEAUX'S PATENT IMPROVED METHOD OF FIXING INSULATORS.

In the ordinary method of fixing telegraphic insulators, the bolt by which the insulator is supported from the arm of the telegraph pole is usually connected with the insulator by one end being inserted and cemented in a hole in the interior of the insulator, the other end of the bolt being fixed in the arm by the screwed end of the bolt being passed through a hole in it, and secured by a screw nut. This method of fixing renders the removal of the insulator for cleaning, repair, or replacement very troublesome. The screw nut has to be unscrewed and the insulator as well as the bolt removed from

the arm whenever a new insulator is required. The rusting of the screw nut and screw sometimes renders the unscrewing of the nut very difficult.

This difficulty of removing the insulators has been attempted to be overcome by more than one inventor. The most apparently obvious method is to make the porcelain portion of the insulator to screw direct on to the bolt; this method, however, is not by any means one which could be practically successful. It is absolutely necessary that the porcelain cup be firmly screwed to the bolt, and the consequence is that the expansion of the iron is certain to split the porcelain. Another method which has been suggested is to cement an iron cup into the porcelain and to screw the bolt into the former, the difficulty first pointed out, however, with reference to the bolt and nut, viz., the rusting of the two portions of the iron together, would apply equally to such a method. It has been found, indeed, that an attempt to unscrew an insulator mounted in this manner has resulted in the porcelain being wrenched out of the iron cup secured to it; the adhesion, through rust, between the bolt and the cup being greater than that between the cup and the porcelain to which it is cemented.

Mr. Cordeaux, of the Postal Telegraph Department, has had these and other difficulties in view, and has devised a method of fixing the porcelain cup to the iron bolt, which is as efficient as it is simple. The method he adopts is as follows :—

A screwed hole is formed in the insulator in place of the plain or unscrewed hole ordinarily made. On that end of the bolt which enters the insulator a screw thread of a size and form proper to engage with the concave or hollow screw or screwed hole in the insulator is cut. The screwed end of the bolt is separated from the plain part of the bolt by a flange or collar or shoulder. In fixing the insulator, a ring or washer of cork, india-rubber, leather, or other yielding substance is placed on the screwed end of the bolt; the insulator is screwed on the screwed end of the bolt, the washer being compressed between the insulator and the shoulder on the bolt when the insulator is screwed home, the washer by its elasticity holding the insulator tightly on the screw and preventing its removal by vibration or other accidental cause.

When it is wished to remove the insulator for any purpose, its removal may be effected by giving it an unscrewing motion when it separates from the bolt, leaving the bolt attached to the arm of the telegraph pole.

Fig. 1 represents in elevation and fig. 2 in vertical section, an insulator fixed to its supporting bolt according to Mr. Cordeaux's method.

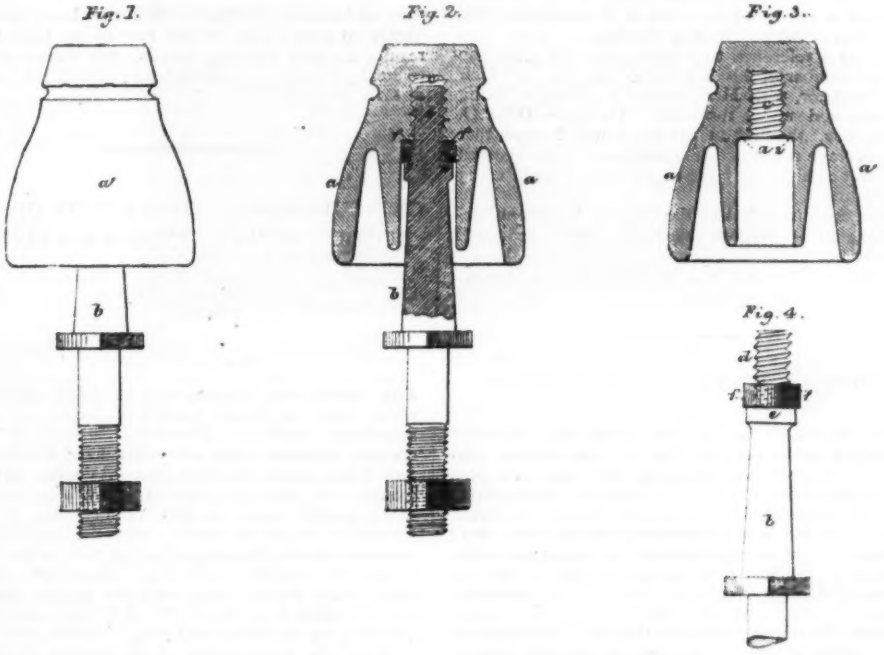


Fig. 3 represents in section the insulator separately, and fig. 4 in elevation the upper part of the supporting bolt separately.

a is the porcelain portion of the insulator; *b* is the bolt by which the insulator is supported, and which is connected to the arm of the telegraph pole in the ordinary manner. In the axis of the insulator and near its head a screwed hole *c* is made, and on the upper end of the bolt *b* is a screw thread *d* of a size and form proper to engage with the concave or hollow screw thread of the screwed

hole *c* in the insulator *a*. Between the screwed end *d* of the bolt *b* and the plain part of the said bolt is a flange collar or shoulder *e*, and supported on the said flange collar or shoulder *e* is a ring or washer *f* of india-rubber surrounding the lower screwed part *d* of the bolt in the manner represented in figs. 2 and 4.

In fixing the insulator *a*, the ring or washer *f* is first placed on the flange *e*, as represented in fig. 4, and the insulator *a* is then screwed on the screwed end *d* of the bolt *b* in the manner represented in figs. 1 and 2. On screwing home the insulator *a* the ring *a* or washer *f* is compressed between the internal shoulder a^2 of the insulator *a* and the shoulder *e* on the bolt, as seen in fig. 2, the washer *f* by its elasticity holding the insulator *a* tightly on the screw *d* and preventing the removal of the insulator by vibration or other accidental cause.

A remarkable feature in this method of fixing is the very high insulating property it gives to the insulator, due, no doubt, to the use of the india rubber washer, and also to the fact that the screwed portion of the iron bolt is not in close contact with the mass of the porcelain of the cup.

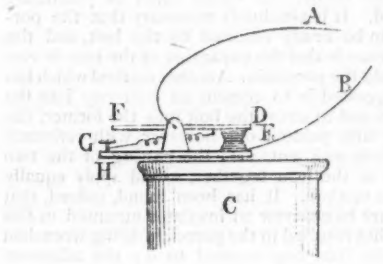
From a reference to a table given on page 190 of the number of this *Journal* for May 1st, in which the insulator, with Mr. Cordeaux's method of fixing is indicated under the name "Porcelain D.S.P.O. large new," the first on the list, it will be seen that the average resistance of a number of tests showed a result as high as 13,374 megohms per mile of 23 insulators.

We understand that the Postal Telegraph department is largely adopting Mr. Cordeaux's method of fixing.

Messrs. Jobson Bros., Phœnix Works, Dudley, are the manufacturers of the insulators.

HUGHES' RECEIVING MICROPHONE.

WE announced in our last issue that Professor Hughes had discovered that any microphone, properly adjusted for speaking, will also act as a receiver, giving forth or uttering the sounds which are communicated to another microphone in circuit, and that the best transmitting microphones were also, as might be expected, the best receiving microphones. He has now designed a special form of microphone for receiving, which gives somewhat louder results than the ordinary "pencil" microphone. The figure represents this special microphone. It consists of a pair of microphonic contacts, made of little studs of pine charcoal, D, E, which are pressed together by means of the pivoted brass lever, F, and the adjustable spring and screw, G. When the spring is tightened, by screwing up the screw G, the pressure of the upper contact D on the lower is increased, and when the spring is slackened, it is decreased. Thus a pressure which gives the best results can be obtained by trial. The base of the contrivance is of light, sonorous, pine wood, and is attached to the top of a drum-head, or resonating box, made of a tin cylinder, C, closed at the upper end by stretched parchment. The wires, A, B, are for connecting this receiving microphone in circuit with the transmitting microphone, which may be of the ordinary "pencil" shape. Professor Hughes employs a battery of six Daniell cells, and, by the help of the resonating drum, is enabled to hear the ticking of a watch and other sounds very distinctly. Speaking heard by this arrangement resembles that



from an imperfectly adjusted Bell telephone, and is hardly so loud; but, for the first of its kind, the results are very striking; and we may expect soon to hear of receiving microphones giving loud and distinct utterance.

ON NEUTRALIZING THE EFFECTS OF INDUCTION BETWEEN TELEGRAPH LINES.

BY CHARLES H. WILSON.

[Read before the American Electrical Society, Chicago, December 12, 1877.]

THE interference between well insulated telegraph wires, now universally known as induction, first manifested itself as a disturbing element, in this country, between wires extending from Omaha to Salt Lake, some few years ago. As some serious trouble had been experienced in working two or more parallel wires in that vicinity, Mr. C. H. Summers, electrician, made some experiments, and reported the interference to be "current induction." It did not manifest itself to any noticeable extent upon wires further east, until the duplex system was introduced, at which time it became apparent, probably on account of the large batteries used.

Since the introduction of the various methods of multiple transmission, the effects of induction have gradually become better known, so that it is now regarded by all who have had experience in working the quadruplex, duplex, and other late improved telegraphic apparatus, to be of no little importance. The possibility of removing this difficulty suggested itself to me about one year ago, at which time some complaints were made of difficulties in operating several Morse wires between Omaha and Sioux City. The ideas were carried out experimentally with good success; but, as it was possible to operate the above-named wires by having a "margin" over the induction currents, the arrange-

ment suggested was not practically introduced. The point in view was to devise a means by which electrical currents, similar to the induced currents, could be established in the same conductor, but made to flow in reverse directions, so that one current would be entirely neutralized by the other.

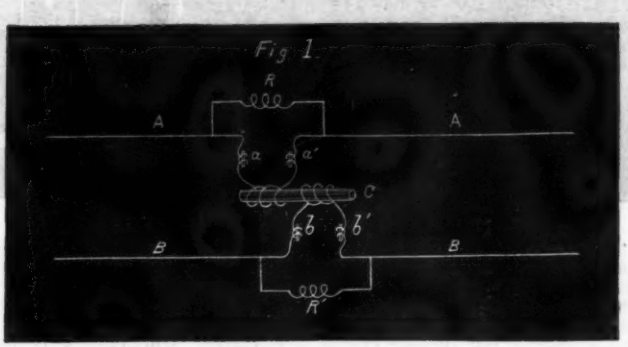
This was accomplished, so far as Morse lines were concerned, by various arrangements of condensers and induction coils. The best results, however, were obtained by the use of the induction coils.

The coils were of No. 30 silk-insulated copper wire, about 300 ohms in resistance, the primary connected in the circuit of one line, the secondary in that of the other. The primary and secondary coils were exactly alike, and were so wound that the battery-currents of the respective lines would pass around the soft iron core in opposite directions when sent from the same end of the lines. It is obvious, from the arrangement of the constituent coils, that the induced currents of the *coil* will flow to line in a direction reverse to the *line-induction currents*.

R and R' shunt the entire combination on either side. These shunts facilitate the essential adjustment of the equating currents, and also lessen the effect of retardation, caused by the helices, to the battery-currents.

Suppose the line A to have a battery at each terminal in the usual manner. On closing the circuit, two induced currents will be generated, flowing in opposite directions; one in the line B, directly; the other, by means of the induction coil C. These will neutralize and obviate the difficulty occasioned by the induction currents from the line.

Arrangements very similar to the above were tested experimentally on wires between Chicago, Buffalo and Pittsburgh, with the hope of removing an interference which disabled the wires to so great an extent that it was regarded as almost impossible to work two of them quadruplexed at the same time. With slight modifications of this arrangement, the inductive disturbance was dissipated, but the reaction of the helices caused by the extra current, interfered somewhat with the transmission of the signals. It



It was at once observed that having the two currents equal in strength was not the only essential condition requiring consideration. The *time* of the establishment of the two currents must be exactly the same in any section of the line where the neutralization is to be effected; otherwise, two currents, opposite in their direction, would be substituted for the single induction current, and they probably would not materially lessen the difficulty. After trying various devices to meet this condition of *time*, the most successful results were obtained by an application of electro-magnets. The artificially induced currents were made to flow through the coils of a series of electro-magnets, which, by their reaction, prolonged the duration of these currents, and, by means of a rheostat, which formed a shunt around them, the proper adjustment was obtained. By increasing or diminishing the amount of resistance in the shunt, the prolonging effects of the electro-magnets can be adjusted at pleasure.

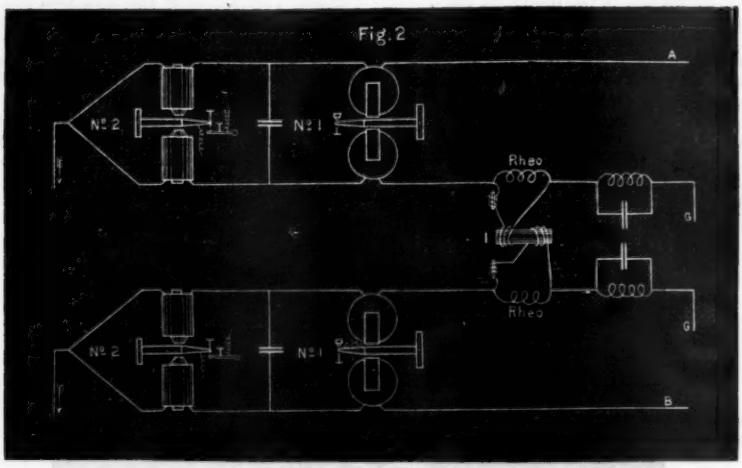
The application of this arrangement to "Morse lines" is shown in fig. 1: C represents an induction coil, constructed with two well insulated copper wires, with an adjustable core of soft iron; *a*, *a'*, *b* and *b'* are electro-magnets placed in the path of the induced currents generated in the coil C, their function being to regulate the *time* of the neutralization of the two induction currents. The rheostats is well known that when an electro-magnet of any considerable size is inserted in a line being worked quadruplex, serious difficulty is experienced in working through it.

In the quadruplex system at present used by the Western Union Telegraph Company, the condition of reversing the poles of the entire battery constantly occurs, and at each reversal there is an instant of no magnetism in the relays at the distant end of the line; and, as a consequence, the armature of the No. 2 relay has a tendency to yield to the force of the springs used to adjust over the "small end" of the battery. When the helices are placed in the line, this neutral space becomes more apparent, and on long lines would cause an interference of signals being transmitted in the same direction. The effects of retardation to reversals were less when the helices were placed in the artificial line, than when in the actual line. This arrangement is clearly shown in Fig. 2.

It is evident that, with the "bridge" or differential principles, all that is required to affect the end in view is to cause the two artificial lines to act upon each other in a manner similar to the action of the actual lines. In the diagram, an induction coil is shown as a part of the artificial lines of the respective quadruplex arrangements, the two wires being well insulated, and wound side by side. The

arrangement approximates sufficiently to the condition of induction between the lines when properly adjusted, which is done in the same manner as in the first arrangement, the same combination of rheostats and electro-magnets being used.

A combination with condensers substituted for the induction coils, is at present used on two wires, one from Chicago to Buffalo, and the other



from Chicago to Pittsburgh. The neutralizing effect of the condensers is very much the same as that of the induction coil, and, on account of the former being more readily adjustable, they have up to the present time been preferred. The former is a new, No. 5 gauge, erected last summer (1877), over the P., Ft. W. & C. R.R., from Chicago to Crestline, Ohio, thence to Cleveland, *via* C., C., C. & I. and L. S. & M. S. to Buffalo. The inductive interference being so great between wires extending from Chicago to Buffalo on the same line of poles as to practically nullify the working of two quadruplex circuits. From Chicago to Crestline, a distance of 279 miles, it is parallel to and within thirteen inches of a No. 6 galvanized wire, extending from Chicago to Pittsburgh. This is the only quadruplex circuit in the vicinity of the new wire.

The induction between these wires at once became apparent to such a degree as to prevent the successful operation of both quadruplexes at the same time. The arrangement shown in Fig. 3 entirely obviates this difficulty, and the simultaneous operation of the two wires has been perfectly successful since its application. Its action is as follows:

If the inductive effects of the two wires are equal, the condenser E is alone necessary to effect the neutralization; but when the two wires are entirely dissimilar, the two diagonal condensers F and G are required in connection with E. If a + current enters line A at *a*, it will divide into two parts, one part passing to the line, and the other to the earth by way of the artificial line. When the line current reaches that section of the conductor which is in proximity to B, a current of comparatively short duration will flow back through the relays of B, and, according to well-established electrical laws, will be in the reverse direction to the inducing current, and another current of short duration will flow in the *same* direction as the inducing current when the battery is withdrawn. At the moment the induced current enters the relays, similar currents, originating in the condensers, also flow back through the other coil of the same instruments, but produce an opposite effect, on account of the differential arrangement of the coils, and, consequently, the magnetic effect of the induction currents is practically rendered null. Each time a current sent into A is *increased*, *withdrawn*, *diminished* or *reversed*, the electrical condition of the condensers between the artifical lines undergoes the same change, and causes thereby a difference in potential on the condenser-plates in connection with line B, the resultant of which is a series of momentary electrical currents between the condensers and the earth. A portion of these currents flows through the relays, there meeting and neutralizing the effects of the line induction currents; *f* and *g* are electro-magnets and resistance coils used to regulate the *time* and adjust the discharge of the condensers so as to exactly equate the line currents.

When a dissimilarity exists in the induction currents of the two lines, the proper adjustment of condensers for one line may not suffice for the other; the two condensers G and F are then used in combination with E. Should A be of a larger gauge of wire than B, or its conductivity be superior from any other cause, it is evident that more artificial line induction will be required to compensate for the influence of B than that of A. When this dissimilarity arises, it is clearly seen that it can be compensated for by properly adjusting G and F. By reference to the drawing, it is clear that the discharge of G will only affect the relays of line B, and that of F will only affect line A. The currents in one direction pass to earth and to line (differentially), and in the other direction add to the discharge of E.

In the above arrangements as applied to the quadruplex, duplex, and other systems on the "bridge" and "differential" principles, it will be observed that nothing has been said of the inductive effects of the out-going current upon the relays at the distant station. On a line of any considerable length where the earth is used as a part of the circuit, the effects of induction do not seem so great at the remote terminal, and the induced current is found to flow opposite in direction to the current caused by the same influence at the "home station:" *i.e.*, when a current is sent into the line, the induced current which is generated and flows to earth at the remote end of the line, is in the same direction as the battery-current, while at the home station it is in the opposite direction. A brief explanation of this is as follows: When the current is sent to line, the latter gradually becomes charged, and as this action takes place the particles of matter in the adjacent conductors, by inductive action, are polarized, "the opposite kind of electricity being attracted and held bound, and the same kind repelled," which flows to the earth according to the law of derived circuits. When the battery current first enters the line, the maximum effect is felt at the home station, and, as it approaches the remote terminal, the effect gradually diminishes until the electrical centre of the other wire is reached, when the first effect is a minimum. From this time the effects at the remote terminal gradually increase until a maximum is reached, when the entire induction current ceases. Similar effects are produced when the current is withdrawn from the line, except that the polarized articles resume their normal condition, and therefore the induced currents will be in the opposite direction to those caused by the polarization. When a current of opposite polarity is sent into the line at the moment of withdrawing the first current, the particles not only resume their normal condition, but they immediately are again polarized, the electricity that was before bound being repelled, causing an opposite current to flow back through the relays.

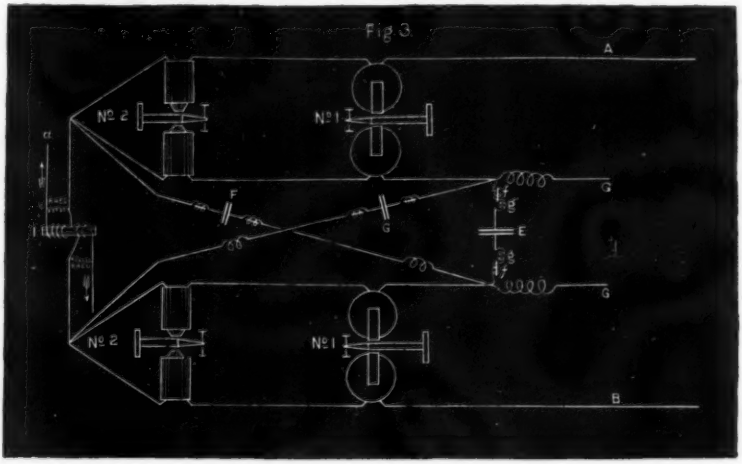
If we suppose the first current sent to line to be +, the induced current caused thereby would also be +, but would flow in the opposite direction. Now, should the battery current be withdrawn, the induced current would again be +, flowing back to line. If at this moment a reversal should take place, the same effect, in addition to a — current flowing from the line would be the result. Of course a — current in one direction produces the same magnetic effect as a — current in the other direction, and, consequently, reversing the battery greatly increases the inductive interference.

It will be observed from the above facts that the requisite direction of the neutralizing current at one extremity of the line would only augment the interference if applied at the other extremity, and, therefore, the neutralizing current must produce opposite effects at the two terminals. The induction coil I., shown in Fig. 3, is used for this purpose. Its two constituent coils are so wound that the currents entering the two lines will flow around the core in the same direction, and thereby cause induced currents of the same kind as those flowing back from the line, and reverse to those flowing to earth at the remote terminal. These currents, when properly adjusted with regard to their *strength*, flow over the line and neutralize the effects of induction upon the remote relays, producing no effect upon the home relays on account of the location of the coil with reference to the differential arrangement.

I found that good results could be obtained by using a condenser made of two well insulated wires wound parallel, with less adjusting than was necessary with the tin-foil condensers. An instrument of this description has a more perfect resemblance to a telegraph line than the combination of electro-magnet and resistance coils, which are necessary to the arrangements when ordinary condensers are used.

With an instrument of this kind, constructed with two well insulated copper wires, the electro-static discharge of the No. 5 gauge wire, from Chicago to Buffalo (538 miles), has been compensated for when

Fig 3.



this apparatus, with proper means of adjustment, was substituted for the combination of condensers ordinarily used for this purpose.

The electro-static charge of a telegraph wire, or any other conductor, is supposed to be caused by induction, "and without this induction the conductor cannot become charged."*

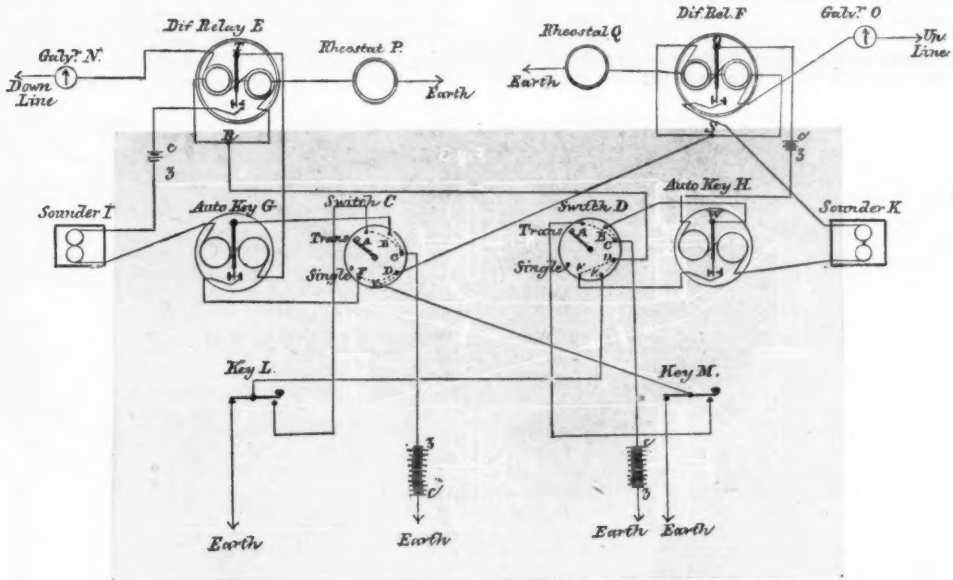
Assuming the above to be a fact, the charge of a telegraph wire must be mostly due to the influence of the earth—the dielectric being the atmosphere. Why, then, would not a smaller gauge-wire, nearer to the earth, have the same capacity as a larger wire a correspondingly greater distance away? Experiment has shown that it will, and it is thought that in the application of condensers in the construction of artificial telegraph lines, this form of condenser will give much better results than the combination with resistance coils at present used to accomplish a *gradual* discharge, which is the condition of the discharge of an actual line.

A SINGLE CURRENT DUPLEX TRANSLATOR.

BY W. DENNETT.

To the Editor of THE TELEGRAPHIC JOURNAL.

The enclosed is a sketch of a Single Current Duplex Translator, for your inspection. Very little explanation of the figures and manner of working, is necessary, as the subject is, no doubt, well known to all your readers.



The switch connections are as follows:—When the handles are turned to the left for translation, B and C are in contact, and A disconnected; D and F in contact, and E disconnected. When turned to the right for single working, or division of line, D and E are in contact, and F disconnected; A and C in contact, and B disconnected.

The incoming current from the "Up" station passing through the differential relay F (Siemens' polarised), closes the local circuit in which another relay H is introduced as an automatic key, whose tongue W is connected to battery B, through switch D. Battery B supplies the power for the "Down" section, which dividing at R, circulates in equal and opposite directions in differential relay E, thus exercising no influence upon its tongue T.

Should the "Down" station be sending at the same time, the "Down" line current from B becomes neutralized, the compensation current then coming into force closes the local circuit, bringing battery A into use for the "Up" line by means of the tongue V of the automatic key G. The current from A dividing at S, as in the other case, completes the translation.

WM. DENNETT.

Dover P. O.

* Faraday.

THE ELECTRIC LIGHT AT NOTTINGHAM.

LAST night at 10 o'clock, in accordance with the arrangements made by the borough engineer, Mr. Tarbottom, Messrs. Siemens Bros., exhibited the electric light at the Health Committee's Wharf in the East Croft, London Road. The light was similar to that exhibited in the Market Place and at the Castle on Wednesday. The effect in and adjoining the wharf was satisfactory, every point being clearly illuminated. A number of gentlemen had been invited to attend on the occasion. Amongst those present we noticed Mr. Councillor Lindley (ex-Sheriff), Mr. Ald. Lambert, Mr. Ald. Woodward, Mr. Ald. Ford (Chairman of the Health Committee), Mr. Councillor Walker, Mr. Councillor Tutin, Dr. Seaton (Medical Officer of Health), Mr. W. Richards (Chief Sanitary Inspector of Nottingham). After the electric light had been exhibited for some time, those present retired to an adjacent office, when Mr. Tarbottom stated that originally it was intended that Messrs. Ball & Co. should illuminate, by means of their light which had been used by the French and English Governments. Large manufactories in Paris had been illuminated by electric lights, and it had been considered advantageous to apply it to those premises in order to see the effect of the application, in consequence of the results which had been produced in Paris. Messrs. Ball and Co., however failed to come forward, but fortunately the promoters managed to fall back on the firm of Siemens Bros., who made the necessary arrangements there in 18 hours. One of the lights was exhibited in the Market Place, and another at the Castle on Wednesday night, but those present had been invited to inspect the light as it was exhibited at the Works of the Health Committee.—*Nottingham Daily Express.*

We may remark that the apparatus employed by the English Government is the same as that exhibited at Nottingham, namely, Siemens' apparatus; and that several manufactories in England now employ Siemens' electric light in preference to gas.

REPORT OF THE AMERICAN COMMITTEE ON DYNAMO-ELECTRIC MACHINES.

THE Board of Managers of the Franklin Institute having empowered its Committee on Instruction to purchase a Dynamo-Electric Machine, it was deemed advisable to examine into the merits of, and to test, the various machines offered for sale. This was undertaken partly as a guide in making a selection for purchase, and also to obtain reliable data regarding the adaptability of such machines to the production of light.

In view of the scientific importance of the work, the Committee on Instruction, which consists of five members of the Board of Managers, availed themselves of the services of four other members of the same, who, by request, assisted in the investigation, and now join in this report.

The work was divided among sub-committees as follows:

On Photometric Measurements, Messrs. Briggs, Profs. Rogers and Chase. On Electric Measurements, Profs. Houston, Thomson, and Mr. Rand. (Mr. Rand's business engagements prevented his taking active part in the work of this sub-committee.) On Dynamical Measurements, Messrs. Jones, Sartain and Knight.

The source of power for the experiments was an upright steam-engine belonging to the Institute. It has 6″ bore of cylinder, and 8″ stroke, heavy fly-wheel 30″ diameter, and governor so adjusted as to give speeds from 100 to 250 revolutions per minute.

The machines submitted to examination were as follows:—Their dimensions are given in Table I: A Gramme machine (similar in form to that given on page 191, Vol. V. of the *Telegraphic Journal*). A large and small Brush machine, which each have for their magnetic fields two horse-shoe electro-magnets, with their like poles facing each other, at a suitable distance apart, the circular armature rotating between them.

In each machine the currents are generated in coils of copper wire, wound upon an iron ring, constituting the armature. This ring is not entirely covered by the coils, as in the Gramme armature, but the alternate uncovered spaces between the coils are almost completely filled by iron extensions from the ring, thus exposing large surfaces of the armature ring for the dissipation of heat, due to its constantly changing magnetism, as in the Pacinotti machine.

The ring revolves between the poles of two large field magnets, the two positive poles of which are at the same extremity of the diameter of the armature, and the two negative poles at the opposite extremity, each pair constituting practically extended poles of opposite character.

The coils on the armature ring are eight in number, opposite ones being connected end to end, and the terminals carried out to the commutator. In order to place the commutator in a convenient position, the terminal wires are carried through the centre of the shaft, to a point outside the bearings.

The commutators are so arranged, that, at any instant, three pairs of coils are interposed in the circuit of the machine, working, as it were, in multiple arc, the remaining pair being cut out at the neutral point; while in the Gramme machine, the numerous armature coils being connected end to end throughout, and connections being made to the metal strips composing the commutator, two sets of coils in multiple arc are at one time interposed in the circuit, each set constituting one-half of the coils on the armature.

The commutator consists of segments of brass, secured to a ring of non-conducting material, carried on the shaft. These segments are divided into two thicknesses, the inner being permanently secured to the non-conducting material, and the outer ones, which take all the wear, are fastened to the inner in such a manner that they can be easily removed when required.

The commutator brushes, which are composed of strips of hard brass, joined together at their outer ends, are inexpensive and easily renewed. The high speed at which these machines are run, together with the form of the armature, cause the rotation of the latter to be considerably resisted by the air, and producing a humming sound, but otherwise they run smoothly; the heating of the armature being inconsiderable, not exceeding 120° Fahr.

after four and three-quarter hours' run. They are simple in construction, all the working parts being easily accessible, and the cost of maintenance low.

In the Wallace-Farmer machine,* the magnetic field is also produced by two horse-shoe electro-magnets, but with poles of opposite character facing each other. Between the arms of the magnets, and passing through the uprights supporting them, is the shaft, carrying at its centre the rotating armature.

This consists of a disc of cast iron, near the periphery of which, and at right angles to either face, are iron cores, wound with insulated wire, thus constituting a double series of coils. These armature coils being connected end to end, the loops so formed are connected in the same manner, and to a commutator of the same construction, as that of the Gramme. As the armature rotates, the cores pass between the opposed north and south poles of the field magnets, and the current generated depends on the change of polarity of the cores. It will be seen that this constitutes a double machine, each series of coils, with its commutator, being capable of use quite independently of the other; but, in practice, the electrical connections are so made, that the currents generated in the two series of armature coils pass through the field-magnet coils, and are joined in one external circuit. This form of armature also presents a considerable un-

The opinions as to the comparative merits of the machines submitted for examination were as follows :—

1. The Gramme machine is the most economical, considered as a means for converting motive power into electrical current, giving in the arc a useful result equal to 38 per cent., or to 41 per cent. after deducting friction and the resistance of the air. In this machine the loss of power in friction and local action is the least, the speed being comparatively low. If the resistance of the arc is kept normal, very little heating of the machine results, and there is an almost entire absence of sparks at the commutator.

2. The large Brush machine comes next in order of efficiency, giving in the arc a useful effect equal to 31 per cent. of the total power used, or 37½ per cent. after deducting friction. This machine is, indeed, but little inferior in this respect to the Gramme, having, however, the disadvantages of high speed, and a greater proportionate loss of power in friction, etc. This loss is nearly compensated by the advantage this machine possesses over the others of working with a high external compared with the internal resistance, this also ensuring comparative absence of heating in the machine. This machine gave the most powerful current, and consequently the greatest light.

TABLE I.

SHOWING WEIGHT, POWER ABSORBED, LIGHT PRODUCED, ETC., BY DYNAMO-ELECTRIC MACHINES TESTED BY A COMMITTEE OF THE FRANKLIN INSTITUTE, 1877-8.

NAME OF MACHINE	Weight in pounds.	COPPER WIRE IN				Revolutions of Armature per minute.	Foot-pounds of power consumed.	Horse-power.	LIGHT PRODUCED IN STANDARD CANDLES.		Foot-pounds of power consumed per candle light.	Size of carbons.	LENGTH OF CARBON CONSUMED PER HOUR.	
		ARMATURE.		FIELD MAGNETS.					Total.	Per h.-p.			+	−
		Size.	Weight.	Size.	Weight.									
Large Brush ...	475	·081 in.	32 lbs.	·134 in.	100 lbs.	1340	107·606	3·26	1230	377	87·4	9/32 × 9/32	1·78	·34
Small Brush ...	390	·063 in.	24 lbs.	·096 in.	80 lbs.	1400	124·248	3·76	900	239	137·	9/32 × 9/32	1·91	·58
Large Wallace ...	600	·042 in.	50 lbs.	·114 in.	125 lbs.	800			823					
Small Wallace ...	350	·043 in.	18¾ lbs.	·098 in.	41 lbs.	1000	128·544	3·89	440	113	292·	¼ × ¼	2·45	·073
Gramme... ...	366	·059 in.	9½ lbs.	·108 in.	57½ lbs.	800	60·992	1·84	705	383	85·	¼ × ¼	3·15	·55

covered surface of iron to the cooling effect of the air, but its external form, in its fan-like action on the air, like that of the Brush, presents considerable resistance to rotation. In the Wallace-Farmer machine there was considerable heating of the armature, the temperature being sufficiently high to melt sealing-wax.

* This machine is very similar to that of M. Breguet, shown on page 101, Vol. IV., of the *Telegraphic Journal*, with the addition, however, of the iron disc.

3. The small Brush machine stands third in efficiency, giving in the arc a useful result equal to 27 per cent., or 31 per cent. after deducting friction. Although somewhat inferior to the Gramme, it is, nevertheless, a machine admirably adapted to the production of intense currents, and has the advantage of being made to furnish currents of widely varying electro-motive force. By suitably connecting the machine, as before described, the electro-motive force may be increased to over 120 volts. It possesses, moreover, the advantage of division of

the conductor into two circuits, a feature which, however, is also possessed by some forms of other machines. The simplicity and ease of repair of the commutator are also advantages. Again, this machine does not heat greatly.

4. The Wallace-Farmer machine does not return to the effective circuit as large a proportion of power as the other machines, although it uses in electrical work a large amount of power in a small space. The cause of its small economy is the expenditure of a large proportion of the power in the production of local action. By remedying this defect, a very admirable machine would be produced.

The Committee regret that a machine of the Siemens' type was not placed at their disposal, since whatever value the determinations may possess, they would then have been increased by embodying data concerning a machine so widely and so favourably known, especially as the Siemens machine employs an armature differing in construction from that of any of the machines examined, wire only being revolved, a construction which theoretically favours economy in working.

ON THE SPECIFIC INDUCTIVE CAPACITIES OF CERTAIN DIELECTRICS.

By J. E. H. GORDON, B.A., Camb. First Series. Communicated by Professor J. CLERK MAXWELL, F.R.S.

THE author has, under Professor Clerk Maxwell's directions, carried out some measurements of specific inductive capacities by a new method. The essential features of it are :—

(1.) It is a zero method.

(2.) The electrified metal plates never touch the dielectrics.

(3.) No permanent strain is produced or charge communicated, as the electrification is reversed some 12,000 times per second.

The potentials of the electrified plates were about equal to that of 2,000 cells.

The following are the results obtained :—The solid dielectrics were plates 7 inches square, and from ¼ inch to 1 inch thick.

Dielectric.		Specific Inductive Capacity.	
Ebonite, 4 slabs of thicknesses ¾, ½, ½, ¼ inch, about.	(1.)	1·5593	Mean ...1·56215
	(2.)	1·5553	
	(3.)	1·5671	
	(4.)	1·5669	
Best quality gutta percha			1·5939
Chatterton's compound			1·6080
India-rubber	black		1·5502
	vulcanised		1·5988
Sulphur			1·6127
Shellac			1·6362
Solid paraffin, sp. gr. ·9109 at 11° C. Melting point 68° C. 6 slabs, each ¾-inch thick, about	(1.)*	1·4986	Mean... 1·49753
	(2.)	1·4943	
	(3.)	1·4920	
	(4.)	1·5033	
	(5.)	1·4936	
	(6.)	1·5034	
†Bisulphide of carbon			1·4474
Chance's optical glass. Slabs nearly 1 inch thick.	Double extra dense flint		1·6840
	Extra dense flint		1·6727
	Light flint		1·6677
	Hard crown.....		1·6872
Common plate glass, 2 slabs, each 1 inch thick, about.	(1.)	1·6933	Mean...1·6918
	(2.)	1·6903	

The author suggests that the fact that all his results are much lower than those obtained by previous experimenters may perhaps be explained on a supposition that the specific inductive capacity of dielectrics increases from an inferior to a superior limit during the first small fraction of a second after the commencement of the electrification. He discusses this question at some length in his paper.

An expression of thanks to Professor Maxwell, for his close superintendence of the work, concludes the paper.—*Proceedings of the Royal Society*,

* These results are corrected for cavities in the plates. The mean of the uncorrected determinations is 1·4864.

† I cannot vouch for the exact accuracy of this determination as the method of experimenting on liquids is not yet quite perfect.

Reviews.

Journal of the Society of Telegraph Engineers. No. XXI., Vol. VII. E. and F. N. Spon, London and New York.

THE contents of this number bring the records of the society's proceedings down to 27th February, 1878. Commencing with the inaugural address of the president (Dr. C. W. Siemens), the number shows that the following papers have been read before the society :—

"The American Telegraph System," by Mr. W. H. Preece, V.P. ; "A Chloride of Silver Element as a Standard of Electro-motive Force," by Dr. A. Muirhead ; "Dr. De la Rue's Chloride of Silver Battery," by Latimer Clark, Past President ; "Byrne's Pneumatic Battery," by Mr. W. H. Preece, V.P. ; "The Logograph," by Mr. H. Barlow, F.R.S., V.P., Inst. C.E. ; "The Phonograph," by Mr. W. H. Preece, V.P.

After an Obituary notice of Samuel Carter, Esq., honorary member, Original Communications, Abstracts, &c., as follows, complete the number :—

"Gaston Planté's New Electrical Machine," by Alfred Niaudet ; "The Wire Finder," by John Gott ; "Automatic Curb-signalling applied to the ordinary hand keys for use on Submarine Cables," by John Gott ; "On a Union or Binding Screw for Temporary Joints," by Arthur M. Stiffe ; "On a Standard Voltaic Battery," by Latimer Clark ; "On the General Theory of Duplex Telegraphy," by Louis Schwendler.

A Handbook of Practical Telegraphy, by R. S. CULLEY, seventh edition, revised and enlarged. London : Longmans, Green, Reader, and Dyer, 1878.

ADDITIONS made in the present edition of this work bring the total number of its pages to 468. The increase has added considerably to the value of the work, giving as it does useful details of some of the most recent advances made in telegraphy, such as

"Fast Speed Translators," "The Telephone," and "Quadruplex Telegraphy."

But whilst Mr. Culley has done good service by making these additions, it is a pity that he did not at the same time recast the general arrangement of matter in the volume so as to connect the various matters dealing with any particular subject somewhat more closely, instead of merely tacking on the additions in a rather disjointed manner. A more copious index might also with advantage have been compiled.

Taking the book as a whole it is very free from extraneous matter, though we occasionally meet with the mathematical developments which are supposed to give valuable assistance in the construction of a line of telegraph. Thus on page 141 *et seq.* we meet with tables for calculating the strains of suspended wires and their stress on struts and stays. We can quite picture to ourselves the intelligent inspector or construction foreman with handbook in hand sitting down to calculate the particular stay he must give to any particular span, or the exact angle at which he must set the stay and the strut so as to properly secure the pole; but although these utterly useless tables appear in the book, yet, as we have said, the work is singularly free from such matter, and, as a rule, only thoroughly practical information is given; to this no doubt the success of the book has been largely due.

In the chapter on "Apparatus and Systems of Signalling," Mr. Culley points out the cause of the diversity of the forms of instruments in use in the postal telegraph service of the United Kingdom. The cause in the first place was due to the fact that, prior to the transfer, the several companies who worked the telegraph system, as it then existed, each had their own special methods; methods, no doubt, due to the caprice of the engineer of the particular company. When the transfer took place, it was of course impossible to produce uniformity without entirely reconstructing the plant. Again, the undertaking being national, it had to be extended to remote villages, too small to give a specially trained clerk the practice needed to keep up his skill, far less to pay his salary. The present arrangement is this, to quote Mr. Culley's own words:—"In villages where the telegraph must be worked by the postmaster or one of the family, the alphabetical dial instrument is used, because it requires no previous training whatever.

"When the traffic is just large enough to employ a trained clerk of the lowest grade, one who can work his instrument but who cannot put it in order should it fail, the needle is used because it needs no adjustment, and very rarely gets out of order, even when a considerable number of stations are in circuit.

"When the business is larger, the needle would be too slow, and the Morse system, either sounder or recorder, is used."

When the business is still larger the duplexed Morse system or the automatic systems are employed.

Although Mr. Culley's book is not a record of telegraph work as it is carried on in different parts of the world, nor, indeed, is it intended to be so, yet it is a faithful record of the very complete system of the United Kingdom, and from this system being a good one, it follows that the information contained n the work must be valuable to those who desire to gain a knowledge of practical land telegraphy.

Notes.

THE TELEPHONE.—A double effect is obtained by holding a telephone to each ear in listening, when the telephones are looped together in "multiple arc," and line is joined to one, while earth is connected to the other.

IT has been found by M. des Portes of the French war-ship *Desaix* that if one telephone of a Bell telephone circuit be deprived of its diaphragm, and freely suspended, a blow given to the bar magnet is heard as a distinct sound in the other or receiving telephone. If the blow be struck with copper or iron, the sound is louder than when struck with wood; and if it be struck by a magnetised piece of iron, a similar effect is heard to that given by soft iron, if like poles be knocked together; but if unlike poles be knocked together, a second and fainter sound is heard when the striking pole is withdrawn. The person at the receiving telephone soon learns to distinguish with what kind of material the blow is struck. In every case the soft iron diaphragm of the telephone, replaced in contact with the coil pole of the transmitting telephone, intensified the sounds heard in the receiving telephone. This is in accordance with its function as an armature.

PROFESSOR ROSETTI of Venice, while experimenting recently with a telephone having a loose coil, found the latter to oscillate along the magnet when a discontinuous current passed in the coil. This motion is evidently due to action and reaction between the coil and the magnet. The above results of M. des Portes and that of Professor Rosetti support the hypothesis of Count du Moncel, that the sounds of a receiving telephone are produced molecularly in the core or magnet itself, and only reinforced by the action of the diaphragm.

IT is said that the Western Union Telegraph Company, U.S., find the best telephone arrangement to be an Edison carbon, or rather charcoal, transmitter, with a Gray electro-magnetic receiver. Since Edison substituted prepared charcoal for carbon in his telephone, it has given better results. This combination gives far louder speaking than two of Bell's telephones. Gray's electro-magnetic receiver was patented in America on the same day as Bell's, but to Bell belongs the credit of making an electro-magnetic transmitter.

THE telephone has been adopted on the mountain section of the Central Pacific Railway, Nevada. Box telephones are connected up every few miles along the track, and the track-walkers report by these to a central office at Blue Canon.

THE MICROPHONE.—Mr. W. J. Millar, C.E., Glasgow, forms an excellent microphonic receiver out of a bar magnet, wound *lengthwise*, with a few yards of No. 30

copper wire. Tuning-fork sounds, singing, whistling, speaking, and violin music were heard distinctly by this simple arrangement.

ON another page we give an account of Prof. Hughes' special microphone for receiving sounds.

MESSRS. PITT AND DOPP, Central School Laboratory, Buffalo, U.S., June 11th, writing to the *Scientific American*, state that a microphone made of a glass tube, filled with No. 12 small shot, acts as a telephone receiver, the sounds being heard by placing the neck of a common glass funnel to the tube, and holding the bar to the cone. They claim to have been at work on the microphone problem for the last six months.

A MICROPHONE, placed on the vibrating diaphragm of a phonograph, transmits the sounds vibrated by the latter to a distance. Has it occurred to anyone yet to reverse this process, and record on a phonograph the inaudible sounds made audible by the microphone?

MR. C. E. DE RANCE, F.G.S., of H. M. Geological Survey, has written to the *Times*, suggesting the application of the microphone as a detector of gas escape in coal mines. The gas issuing from rifts in the coal makes a hissing sound, which, by means of a microphone, telephone, and phonograph, might be registered by night at the pit-head.

WE are indebted to M. de Sussex, Brussels, for some interesting facts about a microphone of his construction. It is an adjustable one, and consists of a small square block of retort carbon, fixed on an empty cigar box, which makes a convenient resonator. A rectangular stick of carbon is supported horizontally over this block by a horizontal spring, so that the end of the stick rests upon the top of the block. A thread attached to the spring is wound round a screw-head, and can be tightened or slackened, so as to increase or diminish the pressure of the stick or upper carbon on the block. To speak with this microphone the carbons ought to be pressed closer than when minute sounds, such as the ticking of a watch, are transmitted. Curiously enough M. de Sussex finds that if a drop of acidulated water be put between the two carbons the sounds are much increased, but the water polarises very quickly, and it becomes necessary to allow the carbons to dry again. This is a very interesting fact.

THE PHONOGRAPH.—It is said that Edison has improved the phonograph so that if spoken to at a distance of 13 feet it will intelligibly reproduce the speech. This increased sensitiveness is largely due to steel bearings having been supplied to the cylinder, so as to give it unvarying uniformity of motion.

PROFESSOR MCKENDRICK, Glasgow, believes that a thin and slightly elastic membrane is the most suitable for giving loud phonograph utterance, a rigid non-elastic membrane being best adapted to give distinctness. From a consideration of the structure of the drum of the ear this is what should be expected.

THE phonograph may bottle up the voice and pass it down to future ages; but the smile that twists the face of a man as he seeks a solitude and gazes upon his name in print for the first time will always have to be guessed at.—*Detroit Free Press.*

LATIN is said to be the language which gives the best results with the phonograph.

SPEECH may be elevated to a whistle by turning the phonograph recording it fast enough, and the whistle may be recorded by a second phonograph, revolving slower, so as to give out the original sound.

THE MEGAPHONE.—The latest as well as the most curious of Mr. Edison's inventions is the megaphone, for which he has but just filed his *caveat*. It is a sort of sound opera glass. By means of its use persons partially deaf are enabled to hear the faintest sound with distinctness. It concentrates and multiplies the sound in as high a degree as is required. By applying it to the ear at a high rate of adjustment a whisper can be distinctly heard 300 feet away. Mr. Edison has already tested it sufficiently to be satisfied of its entire practicability. It is to be of small size, and have attached to it a rubber tube. In the inventor's own words "It can be taken to a theatre by a person hard of hearing, just as a person now takes his opera glass. All you do is place it on your lap, let the tube touch your ear, and all sounds come to you magnified fifty times if necessary. The loudness can be regulated for the ear as you regulate a telescope for the eye."—*The Operator.*

THE EASTERN TELEGRAPH COMPANY have made arrangements with her Majesty's Government and the Government of the Sultan for the extension of the company's cable system in the Levant. Several sections have already been laid, and the other sections are in progress. Part of the cost of these works has been paid by the English Government, and the balance is expected to be defrayed by the company without the issue of fresh capital. The cable from Tenedos to Constantinople is now laid.

A MEETING of South African merchants presided over by Mr. Donald Currie was recently held at Cape Town to press upon the Home Government the necessity of an early cable connecting England to South Africa, leaving it to the Government to settle whether it should be an east or a west coast cable.

EDDYSTONE LIGHTHOUSE.—A deputation from Plymouth had an interview on Friday with Lord Sandon, at

the Board of Trade, to ask the Government to erect a telegraph station at the new Eddystone Lighthouse. A memorial having been presented, and speeches delivered on the subject, Admiral Sir R. Collinson, from the Trinity House, said they did not consider it necessary, and Mr. Patey, from the General Post Office, expressed the same view. Lord Sandon said it was not a very simple matter. As to the signal station, he agreed abstractly that with a great shipping nation like ourselves the more stations the better, and he quite understood that Plymouth should wish to have it for her own purposes. He saw the local reasons quite clearly. But the question arose whether it was not merely a local matter, and not one which ought to be taken up by any public body. So far as he had been able to ascertain there was no precedent for the Mercantile Marine Fund being used for such a purpose, and he should be loth to set the precedent of using it for a purpose for which it was not intended. He would be quite ready to consider an application from Plymouth to lay the wire to the lighthouse, providing that the men put there and the signalling were completely under the control of the Trinity House; but he could not promise anything in the matter.

SOME postal and telegraph reforms have just been carried out in Mauritius. The charge for a message of twenty words is reduced to 25 cents., an example which might be held up to India, where an inland message of six words costs 50 cents. An extra charge is made for messages on Sunday, a proceeding which our contemporary the Port Louis *Mercantile Record* cannot possibly understand.

A DEPUTATION consisting of the chairman, directors, and secretary of the West India and Panama Telegraph Company waited upon Sir Michael Hicks Beach, at the colonial office recently, upon the subject of telegraphic communication with the West Indies.

THE Great Northern Telegraphic Company's Amoy-Shanghai Cable is interrupted, so that messages for Hongkong and Amoy (Foochow) cannot be accepted. During this interruption the Company's line is the only Telegraph route to Shanghai, and to all stations in Japan.

WE are glad to learn that a movement is on foot to present a testimonial to Mr. Paul Le Neve Foster, on the occasion of his completing his twenty-fifth year of service as Secretary of the Society of Arts.

OUR contemporary *La Nature* reports, that during a recent thunderstorm at Saint-Révérien (Nièvre) a stroke of lightning entered a dwelling house by the chimney, upsetting several dishes, and, oddly enough, boring its way through a pile of plates, missing each alternate plate. Moreover, the bolt escaped by a window, breaking the glass in pieces. A girl sitting in the doorway was paralysed in her legs by the shock.

MR. W. R. PLUM, a Chicago attorney, but formerly a practical telegraphist, is collecting materials for a history of the United States Military Telegraphic Service. It will be remembered that the late American Civil War was the first occasion on which telegraphy played an important part in warfare, and the work proposed, if well done, should be a most interesting one.

FIRE TELEGRAPHS IN NEW YORK.—An improved fire alarm system, arranged by Messrs. Emrich and Smith, is now in operation at Fireman's Hall, New York. It comprises 60 circuits of 120 wires, 550 street boxes, and 85 stations connected up to head quarters. The wires are connected through lightning arresters to a main switch board of slate 16 ft. long by 3 ft. wide, containing 800 switches. A galvanometer is connected up in each circuit to show at all times the strength of current in it.

A SUIT between the Atlantic and Pacific and Western Union Telegraph Companies, U.S., about their rights to the employment of Prescott and Edison's Quadruplex, has just been decided against the former company. It appears, from the *Operator*, that Edison has made five contracts in this matter, first in 1871, assigning half his interest in all inventions in "automatic" telegraphy to Mr. Harrington, of the *ci-devant* Automatic Telegraph Company, for the ensuing five years; and, secondly, supplementing this by giving up the whole of his interest in said inventions. These contracts, which had been considered inoperative since the break-up of the Automatic Company, passed by sale through several hands, finally coming into the possession of the Atlantic and Pacific Company. In 1873, Edison made a contract with the Western Union Company, who facilitated his experiments, giving to them his prospective inventions in duplex and quadruplex. Next year he made a fourth contract, assigning to Mr. Prescott half of his own interest in duplex and quadruplex, on condition that they should work together at it. When the quadruplex was perfected in 1874, it was offered to the Western Union for 25,000 dollars cash, and 233 dollars for each circuit on which it was used. Mr. Orton was absent from New York at the time, and some delay took place. Meanwhile, Mr. Edison, in January, 1875, contracted with the A. and P., and assigned his inventions in duplex and quadruplex to them for 30,000 dollars. About the same time Mr. Orton accepted Edison's above offer on behalf of the W. U. Company. Mr. Edison, in reply to Mr. Orton, said he was advised that the previous contract with Mr. Harrington would prevent his assigning the patents to the W. U. The A. and P. brought up the suit, and claimed that its right to duplex and quadruplex was included in the 1871 contract with Harrington; but Judge Sanford ruled that this was not the case, and legalised the W. U. claims.

MISHAPS OF TELEGRAPH LINES.—M. Lohse has published in the *Archir fur Post und Telegraphie* (1877, 298) on the subject of faults in the German telegraph lines, a very detailed account, from which we extract the following facts. The year had not been a favourable one for the lines; the hurricanes, from the 12th to the 13th of March, and from the 12th to the 13th of November, having caused considerable damage. The first of these hurricanes put temporarily out of service nearly two-fifths of all the lines. The total number of derangements during the year was 6,198, of which 87 per cent. were country lines, 7 per cent. town lines, 1½ per cent. cables, and 4½ per cent. office leads. . . . On grouping the faults according to their causes, we find that 26 per cent. were due to atmospheric influences, 15 per cent. to falling rocks, or earth slips, 3 per cent. to mischief or carelessness, $\frac{5}{10}$ per cent. to the flight of birds against the wires, or kite strings. The remaining $54\frac{7}{10}$ per cent. could not be accounted for. The faults were 1,708 broken posts, 3,284 broken wires, 4,114 damaged insulators, 2,706 broken binding wires. The system in which they occurred only comprised in the year 1876, 37,264 kilometres of line involving 136,891 kilometres of wire. There was, therefore, a broken post for every 21·7 kilos. of line, a broken wire for every 41·7 kilos. of wire, and a leakage for every 31·2 kilos. of wire.—*Journal Telegraphique.*

Patents.

2527. "Telephones."—C. W. SIEMENS (communicated by W. Siemens), June 25.

2554. "An improved telegraphic apparatus."—C. A. BRAMAO, June 26.

2640. "Improvements in and connected with magnets to be used for separating metallic substances from materials used in the manufacture of pottery and other manufactures."—E. LEAK and J. EDWARDS, July 2.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

4059. "Circuit closers for electric alarms" (communicated by S. S. Applegate). Camden, New Jersey, U.S. Dated November 1, 1877. 6d. This consists in a portable circuit closer or key, which may be fixed in any position, such as the door-mat or window of a house. The device for a mat consists of short elliptic metal springs fixed to a number of wooden slats secured to the mat. The springs yield to pressure, and are pressed by the footfall of a passenger into contact with two metal contact pieces, thus completing the circuit, and actuating an alarm.

4232. "Magnetic apparatus for ringing bells."—GEMINIANO ZANNI. Dated November 13, 1877. 6d. Improvements on a former patent of the author's, No. 2721, 1871, whereby the circular magnets therein described are dispensed with, and a horse-shoe electro-magnet substituted.

4275. "Producing electric light."—F. W. HEINKE. Dated November 15. 2d. This describes the employment of two carbon discs as electric wicks rotating by clockwork opposite to one another. The carbons are regulated by means of the clockwork or by the indraught of air caused by the combustion of the carbons. For this purpose the latter are enclosed in glass or metal cases with holes or tubes in them to direct the indraught so that it can rotate a fan. (*Not proceeded with.*)

4321. "System of double telegraphic transmission."—J. X. E. SIEUR. Dated November 19, 1877. 6d. The principle of this invention is as follows:—A cam, connected to earth, is caused to revolve rapidly between two contact springs, one of which is connected to the positive pole of the battery, the other to the negative pole. These springs are thus caused to oscillate rapidly to and from their respective contacts—the one of which is connected to one signalling key, the other to the other signalling key. Both of these keys are connected to one line wire, which thus receives positive intermittent currents from one key, and negative ones from the other. The receiving instruments are a pair of polarised relays, one of which responds to positive and the other to negative currents. Thus one message is received on one relay, and the other on the other relay. By employing the duplex mode of arrangement, a quadruplex system of transmission may be obtained.

4341. "Applying wires for conveying electricity."—ALEXANDER GRAHAM BELL. Dated November 20, 1877. 4d. This consists in overcoming the inductive disturbances from extraneous lines on telephone circuits by using a return wire very close to the outgoing wire.

4402. "Telephone."—J. A. EWING and Prof. FLEEMING JENKIN. Dated November 22, 1877. 2d. This consists of wires or groups of wires capable of vibrating to definite musical notes, stretched so as to vibrate across the lines of magnetic force, the circuit being always closed. The electric vibrations set up at one end give rise to similar vibrations at the other. By grouping the wires, a number of audible signals may be given without interference. (*Not proceeded with.*)

Correspondence.

[We do not hold ourselves responsible for any opinions expressed by our correspondents.—ED. TEL. JOUR.]

THE MICROPHONE AND THE TELEPHONE.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—I have noticed in several recent American newspapers, references to the lectures upon Professor Hughes' microphone, which were delivered before the Society of Telegraphic Engineers and other institutions a few weeks since by Mr. W. H. Preece, in which not only is the credit of the invention or discovery of Hughes claimed for Mr. Edison, of New Jersey, U.S.A., but it is directly charged that Mr. Preece, in violation of confidential communications made to him previously by Edison, had imparted the knowledge of the same to Professor Hughes, thus enabling the latter to announce the discovery in Europe as his own.

It is wholly unnecessary for me to undertake to vindicate the reputation of either Mr. Preece or Professor Hughes in a community in which both gentlemen have been well known for at least 20 years.

I trust you will allow me the space to make public the facts, the overlooking of which appears to have led Mr. Edison, no doubt with entire sincerity, to make reflections on the two gentlemen named, and to which a syndicate of sensational American newspaper writers has given an unfortunate currency. The statement of these facts will dispose of these reflections, and at the same time correct an erroneous opinion quite general in Europe in regard to the origin of the invention of the speaking telephone.

On the 14th day of February, 1876, Elisha Gray, of Chicago, filed in the United States Patent Office, a *caveat* with drawings annexed, which show that he not only apprehended the principle of the articulating telephone at this date, but that he had actually devised a practical speaking telephone, depending on a method discovered by him for *controlling the resistance of a constant current by varying the contact surface between two conductors, one of them being thrown into vibration by the action of the voice upon the atmosphere.* This *caveat* of Gray was the *first document ever placed on record anywhere* describing an articulating or speaking telephone with complete drawings of an operative apparatus.

On the 30th July, 1877, Mr. Edison made a provisional application for protection in Great Britain for his speaking telephone. In this document he described many forms, and whilst he made known a principle and devices entirely original with himself, all the forms described by him involved the principle so fully set forth above, as in Gray's *caveat*, viz., that of controlling the resistance of a constant circuit by the action of the sound waves. He also described a method of regulating the resistance of the circuit by the amount of contact surface between two conductors, one of them being moved by the diaphragm, and this was also Gray's invention. The new fact discovered and announced by Edison was that *the specific resistance of a piece of carbon is altered by variations of pressure.*

It is thus evident that the principle that is common to Edison and Hughes was set forth in the *caveat* of Gray, eighteen months before Edison's application was made in Great Britain, and it is clear that, thus far, the facts and principles involved, considered according to the order and the source of their development, afford no basis for the complaint that has been made. I ask attention now to the single point of the invention of Hughes, that is not either covered by Gray, or common both to Hughes and Edison.

Professor Hughes discovered that when a chain of separate conductors were placed lightly in contact with each other, forming a circuit, the slightest vibration communicated to them would cause a wide variation in the resistance. In this manner he was enabled to produce results that were not possible with the apparatus either of Gray or with that of Edison.

If there has been any breach of confidence on the part of Mr. Preece, or any unfair appropriation of Edison's inventions by Hughes, it can have taken place only on this one point. In all the loose discussions in the American newspapers, no such specific charge has been made, and it is fair to assume that no ground for it exists; and, above all, no assumption, injurious to gentlemen so well known in both hemispheres, should be entertained for a moment without the specific allegation to this one point, and the production of the proofs.

From a careful consideration of the facts and principles involved, I have arrived at the conclusion, in which I think you will agree with me, that this unpleasant affair originated first in misconception of the actual questions at issue, and, second, in the rather excessive sensitiveness that all inventors are supposed to be subject to in respect to conflicting claims to priority.

FRANK L. POPE.

Paris, June 28th, 1878.

General Science Columns.

CONTINUOUS BRAKES.

PART IV.

CLARK AND WEBB'S BRAKE.

Clark and Webb's Brake, which is an improvement upon Clark's Chain Brake, has attained some notoriety from its adoption so persistently by the North-Western Railway in spite of the repeatedly expressed opinions of the Board of Trade as to its inefficiency as a continuous brake at the present day, when more efficacious brakes are in daily use on other lines, which have repeatedly proved their greater value and usefulness. In this brake a chain, or steel rope, runs the entire length of the train, underneath the carriages, terminating in the guard's van, by means of which the brakes are applied to the wheels of every carriage. With this brake the train is usually made up in sections, each of which is supplied with a brake apparatus. Each carriage is provided with its own length of chain and couplings. The chain passes over seven pulleys fixed under the framings of the carriage, and under one pulley carried by levers in connection with tension rods attached to the brake blocks. When a chain throughout a section is coupled up, one end of it is made fast to the end of the extreme carriage of the section, whilst the other is led to a chain barrel hung under the framing of the guard's van at the other end of the section, close to the centre axle of the van. On the chain barrel, and also on the van axle, there are friction wheels, and by releasing a weighted lever in the van the friction wheels are brought into contact, and, if the van is in motion, the chain barrel is made to rotate. By this means the chain throughout the section to which the barrel belongs is tightened, the pulley carried by levers under each carriage is raised by the chain, and the brakes are applied to the wheels. The van from which the brakes of a section, both in front and behind of it, are actuated has two chain barrels set in motion by the release of one weighted lever. To release the brakes, the guard in each van has to put back the lever into its normal position, and secure it with a catch, at the same time releasing the brakes by a weighted lever arranged for the purpose. In order to place the brakes of a whole train at the command of the driver, a cord is passed over the roof of the carriages to the engine, by means of which the driver is enabled to release the catch holding the weighted lever in each guard's van, but the guards can only apply the brakes to their own section. The application of this brake being dependent upon the winding in of the slack rope or chain, it necessarily follows that its action must be both slow and gradual, in proportion to the length of each section of the train. Its mean retarding force also is not high, having been proved by the Commissioners to amount only to 7·79 per cent. of the gross train load with the use of sand, and 6·21 per cent. without sand. In effective power this brake took the next place after the Westinghouse

Automatic, the distances within which the train was brought up being, with sand, at 30 miles an hour, 385 feet; at 45 miles, 866 feet; and at 60 miles, 1,540 feet; without sand they were 480 feet, 1,080, and 1,920 feet respectively, in this latter instance being slightly behind Barker's Hydraulic Brake. Writing to the London and North Western Railway Company on the subject of an accident which occurred on the 15th August last, between the Moor and Warrington stations on that line, the secretary to the Board of Trade remarked that although the brakes on six vehicles were applied at least 1000 yards from the point of danger, and the engine was reversed at least half a mile from that point, the brakes on two or more vehicles were applied at 300 yards, and those on the remaining vehicles at 250 yards, the train had yet a residual speed of from 4 to 6 miles an hour when the point was reached; and this it is added, "happened to one of the most important express trains running on one of the most important trunk lines in the United Kingdom. These facts," it is further remarked, "amply prove that the brakes used by the company cannot in any reasonable sense of the word be called continuous brakes, and that they are not under the control of the driver. They are merely sectional brakes under the control of different persons in different parts of the train, and there are no sufficient means of communication between those different persons, so as to enable them to apply the whole of the brakes at the proper moment."

BARKER'S HYDRAULIC BRAKE.

The hydraulic apparatus applied by Barker to actuate railway brakes comprises a double acting steam accumulator on the engine, consisting of a large sized cylinder with a piston in it connected with a plunger working in a second cylinder, which is kept filled with water from the tender-tank. The piston in the former is actuated by pressure direct from the boiler, without the use of any pump, and in making its stroke the plunger in the smaller cylinder is made to force water, with any degree of pressure, into pipes leading from small hydraulic rams attached to the engine and carriage brakes. These pipes are continued the whole length of the train; the connections between the carriages being made with india-rubber hose furnished with ordinary unions. Each carriage is fitted with two of the hydraulic cylinders and rams, which are connected directly to the break-blocks in such a manner that on the ram of each cylinder being moved by the pressure of water from the accumulator, the break-blocks on one side of the pair of wheels to which the ram belongs are forced against the wheels, while the pressure of water against the bottom of the same cylinder causes it to recoil, as it were, and draw the tension rods of the brake-blocks on the other side of the pair of wheels, thus clipping each wheel between its two blocks. By reverse action in the accumulator the pressure in the brake cylinders can be relieved, and the blocks taken off from the wheels. The amount of pressure in the pipes can be regulated by a reducing valve; also, in order to keep the power always ready for immediate use, it is an essential part of this system that the pipes and cylinders throughout the train should be always full of water. In the event of a leak occurring in any part of the pipes the efficiency of this break would, no doubt, be seriously interfered with, but when in proper working order it is a very powerful brake. If a coupling breaks, however, the rear portion of the train is placed beyond control by the continuous brake. In experiments made to test the time required for the brake to be put into action, it was found to occupy from 3 to 5¼ seconds before exercising its full power, and from 8½ to 18½ seconds to take off. The mean retarding force was found to be 7·64 per cent. of the gross load with the use of sand, and 6.47 per cent. without it. The distances run by the experimental train before being brought to a stand were greater than with the Clarke and Webb Brake when sand was used, but somewhat less without sand; they were as follows: with sand, at 30 miles an hour 393 feet; at 45 miles, 884 feet; and at 60 miles, 1,572 feet; whilst without sand they were 465, 1,046, and 1,860 feet respectively.

SANDERS VACUUM BRAKE.

The brake known as the Automatic Vacuum Brake has, for some time past, been in operation on the Great Western Railway, but few particulars of its working have been made public. In the application of the principle adopted by Mr. Sanders, a pipe extends under the carriages the whole length of the train, the pipes of each carriage being connected together by flexible couplings. In this pipe a vacuum is created by means of an ejector on the engine, and it is subsequently maintained by an exhausting pump, worked from a reciprocating part of the engine. The function of this pump is, therefore, not to create the necessary power, but to maintain it by withdrawing the air, which must of necessity find its way into the pipes through leakage. On each carriage are two drums with flexible heads, of different areas, which, being connected with the continuous pipe and to the brake gearing, pull in opposite directions. The larger drum of the two is employed to keep the brakes out of action, and the smaller one for applying them. In the connection between the smaller drum and the continuous pipe is a self-closing valve. The action of the brake is as follows:—When the vacuum is created in the continuous pipe, the air is simultaneously withdrawn from both drums, but the pressure of the atmosphere acting upon the head of the larger drum overbalances that upon the head of the smaller one. As they are both connected to the opposite ends of the same lever, the difference of power in the larger drum over that of the smaller is constantly employed in keeping the brakes out of action. In order to apply them it is necessary to destroy the vacuum in the larger drum, which is done by admitting air into the continuous pipe by means of a valve on the engine or in the guards' vans, or by an accidental separation of

the train or disconnection of the couplings between the carriages. The admission of air into the continuous pipe does not, however, destroy the vacuum in the smaller drum on account of the valve before described sealing it; a valve is, however, provided for admitting air to the smaller drum if necessary. The action of the two drums is as follows:—The effective power of the larger or releasing drum is 380 square inches × 10 lbs. vacuum = 3,800 lbs., whilst that of the smaller or applying drum is 314 inches × 10 lbs. = 3,140 lbs. There is, therefore, with a 10 lbs. vacuum, an excess of power equal to 660 lbs. in each releasing drum, acting in the direction of keeping the brakes constantly out of action. When the normal vacuum in the continuous pipe is reduced, say 17½ per cent., the two drums are put into equilibrium; but this diminution of pressure does not apply the brakes, because the larger drum is still pulling with equal power against the smaller. The brakes can only be put on by still further reducing the vacuum in the larger drum; and, in proportion to such reduction, the applying drum is permitted to apply them. The following are the results of experiments made with this brake on the Great Western Railway last January:—The train consisted of an engine, tender, five carriages, and two guards' vans, the total weight being 166 tons 12 cwts. The first stop made was on a falling gradient of 1 in 754, speed 56 miles an hour, and the vacuum at 16¼ inches; the train was brought to a stand in 40 seconds after the first application of the brake, during which time it ran a distance of 1,931 feet. The second experiment was also on a falling gradient of 1 in 754. The speed was 47 miles an hour, and the vacuum gauge denoted 18½ inches. A stop was made in 28 seconds in a distance of 1,173 feet. The next was on a rising incline of 1 in 660, speed 51 miles, vacuum 19¼ inches, the distance run, after application of the brake, was 1,245 feet in 30 seconds. Lastly, the train was brought up on a rising gradient of 1 in 834, the vacuum being 18½ inches; the time taken to effect a stoppage this time was 28 seconds, and the distance run, after the application of the brakes, 1,110 feet.

PROPERTIES OF GALLIUM.—Crystals of gallium are formed by introducing a platinum wire carrying a small grain of solid gallium into the metal, cooled some 10° or 15° C. below the point of fusion. It is hard and immalleable. Under the hammer it lengthens and takes the polish of the anvil, but it rapidly breaks asunder. Despite its high degree of hardness, gallium leaves strong blue-gray traces on paper. It preserves its lustre in a laboratory in which the air is always charged with acid vapours; it remains equally brilliant in boiling water; but it slowly tarnishes in aerated water. The metal in fusion is of a white akin to that of silver or tin. Prepared cold, from a potassium solution, by means of electrolysis, it crumbles when it is thrown into warm water, and allows bubbles of gas to escape. At ordinary temperature, chlorine attacks gallium energetically with great disengagement of heat; the action of bromine is less violent than that of chlorine; to obtain the iodide, it is necessary to heat slightly.

RESISTANCE OF THE AIR IN THE TORSION BALANCE.—Recent experiments on this subject by MM. Cornu and J. B. Baille lead to the law that, the resistance of the surrounding air to the motion of the index or lever of a torsion balance is proportional to the first power of the angular velocity of the index.

ACTION OF OZONE ON IODINE.—M. Ozier finds that the passage, or electric discharge through a tube containing oxygen and vapour of iodine, is attended by the formation of periodic acid as well as the lower oxides of iodine.

OXIDATION OF ALUMINIUM.—MM. Henze and Jehn, experimenting on the peculiar oxidisability of aluminium when rubbed with mercury or its salts, attribute the phenomenon to the formation of molecular galvanic elements with the aluminium, mercury, and moisture condensed upon them. When the metals are dry and in a dry atmosphere, there is no oxidation. Other electro-negative elements yield similar results; for example, aluminium in contact with moist platinum becomes covered with alumina. In this experiment, silver, tin, gas coke, &c., give the same deposit. It is curious that the alumina formed by these methods increases in amount after being rubbed. MM. Henze and Jehn explain this by supposing that the oxygen which was polarised during contact subsequently acts on the metal.

ON THE VARIATIONS OF TERRESTRIAL MAGNETISM.—M. Quet examines by the aid of the calculus, the direct action of the sun upon the magnetism and electricity of the earth. If we consider a hypothetical earth, properly constructed with regard to conductivity and magnetic capacity, turning upon its own axis and describing an orbit round a sun traversed by electric currents sufficiently intense to act with efficacy upon it. If we examine in turn all the effects of constant and variable forces, and apply the general principle of Laplace, that the state of a system of bodies becomes periodic, like the forces which actuate it, when the effect of the primitive conditions of movement have disappeared under the action of resistances. This fictitious earth will become magnetic; it will have its boreal magnetic pole north of the equator and the austral pole south of it. Its atmosphere will be charged with positive electricity, of which, the tension will increase with the height above the level of the ground. The layers of air next the ground will be electrified negatively. At the surface of this earth, compass needles will experience continual changes, both in the direction of the needle and in the intensity of the magnetic force upon it. These changes will follow

a daily variation, regulated by the solar hours. The direction of this daily variation will be contrary in the two hemispheres separated by the equator. The diurnal variation will be accompanied by an annual inequality. For this inequality the deviation of the compass will be in the same direction in the two hemispheres. There will be also an annual variation corresponding to the solar months. Perturbations on the needle will be observed if the solar currents vary in intensity. At the same instant of time the austral pole of the declination compass will suffer, over the whole earth, simultaneous but unequal deflections, great in some regions, small in others, here directed towards the east, there towards the west. If the state of the sun varies periodically, these perturbations will be correspondingly periodic. The magnetic needle would then serve to indicate electro-dynamic changes in the sun. The hypothetical earth that we have considered offers a striking image of what passes on our globe, and seems to increase the probability of the theory of direct solar action on terrestrial magnetism.—*Les Mondes.*

CANDLES ALTERED BY LONG EXPOSURE TO SEA-WATER.—Dr. J. H. Gladstone has published the results of a curious analysis which he recently made into the condition of some tallow candles forwarded to him by Mr. Latimer Clark, and recovered in 1875 from the wreck of a Dutch treasure ship sunk in Vigo Bay in 1702, that is 173 years before. The wick was found to have rotted away, but the tallow had become a heavy friable substance of a dull white colour, which, however, contained portions of fat apparently unchanged. The pure fat could easily be separated from the remainder by treating the candles with ether and benzine. On completely burning a candle there remained a strongly alkaline white ash, consisting of carbonate and chloride of calcium and sodium, with traces of magnesium and potassium. The fat had, in fact, been converted in great part into calcium and sodium salts, doubtless by the slow replacement of the triatomic group, C_3, H_5, in the stearine by three atoms of the metal, with the simultaneous production of glycerine. That this double decomposition has proceeded so slowly as to be only half completed at present, is, as Dr. Gladstone remarks, the most interesting point brought out.

THE "Harmonic Analyser," or machine for calculating the integral of the product of two given functions, which was invented and brought before the Royal Society by Sir William Thomson and his brother, Professor James Thomson, is to be employed in the Meteorological Office for tidal analysis.

NEW OBSERVATORIES IN FRANCE.—By a decree, of date March 11, three new astronomical and meteorological observatories, namely, one at Besançon, one at Bordeaux, and one at Lyons, have been fitted out in France. There are now eight astronomical observatories in that country.

NEW CRATER IN THE MOON.—Dr. H. J. Klein, of Köln, announces the appearance of a new crater on the Mare Vaporem, a little to the north-west of the well-known crater Hyginus. It is about three miles in diameter, gloomy and deep, with a ragged edge. The Mare Vaporum is situated near the middle of the visible surface of the moon. Dr. Klein has carefully examined this region for the last twelve years, and there is little or no room for doubt that a new crater has been formed on the lunar surface, bearing witness to the moon's actual volcanic activity.

City Notes.

Old Broad Street, July 15th, 1878.

THE report of the Eastern Telegraph Company shows that the Company's revenue for the six months ending March 31, amounted to £298,114. Deducting £58,101, the ordinary expenses of the concern, £26,179 special expenditure during the half year, £602 for bad debts, and £1,501 income tax, the sum available for dividend is £151,729, or adding the amount brought forward from the preceding half-year, £164,509. The Directors have, during the half-year, paid an interim quarterly dividend of 1¼ per cent. on the ordinary shares, and this with the dividend of 2s. 6d. per share now to be paid, will make a total of 5 per cent. on the ordinary shares, the dividend on the preference shares being at the rate of 6 per cent.

We do not know that the Revenue account calls for any special notice, though £26,000 is a large sum even for extraordinary expenses. Again, £602 for bad debts is a considerable item. In the balance sheet we notice that while the bills payable only amount to £1,184, the bills receivable approach £36,000, and the deposits and loans on security are £111,000. It is, of course, for the shareholders to inquire into the details of sums like these. The Joint Purse agreement recently established between the Indo-European and the Eastern Company is to be extended to the Indo-European Telegraph Department of Her Majesty's Indian Government, also we note the Company's system of cable is to be extended in the direction of Constantinople.

We are informed by the manager of the Direct Spanish Telegraph Company, Limited, that the rates to Portugal and Gibraltar by the company's Direct Spanish cable route have been considerably reduced. Thus, in future, a telegram of 20 words may now be sent from London to Portugal or Gibraltar for eight shillings, and from the country to Portugal for eight shillings and sixpence, or Gibraltar for nine shillings. Telegrams, if not written on the company's forms, should be directed *via* Spanish.

The following are the latest quotations of telegraphs: Anglo-American, Limited, 63⅞-64¼; Ditto, Preferred, 92½-93½; Ditto, Deferred, 36-37; Black Sea, Limited, 2-3; Brazilian Submarine, Limited, 6⅞-7⅛; Cuba, Limited, 9¼-9¾; Cuba, Limited, 10 per cent. Preference, 16-17; Direct Spanish, Limited, 1⅞-2¼; Direct Spanish, 10 per cent. Preference, 9½-10; Direct United States Cable, Limited, 1877, 14¼-14½; Eastern, Limited, 7⅝-7⅞; Eastern, 6 per cent. Debentures, repayable October 1883, 108-111; Eastern 5 per cent. Debentures, repayable August 1887, 103-105; Eastern 6 per cent. Preference, 11⅜-12; Eastern Extension, Australasian and China, Limited, 7⅞-8; Eastern Extension, 6 per cent. Debenture, repayable February,

1891, 108-111; German Union Telegraph and Trust, 8⅞-8¾; Globe Telegraph and Trust, Limited, 5⅝-5⅞; Globe 6 per cent. Preference, 10⅞-11⅛; Great Northern, 8¼-8⅝; Indo-European, Limited, 19⅜-20¼; Mediterranean Extension, Limited; 2⅛-3; Mediterranean Extension, 8 per cent. Preference, 9¼-9⅝; Reuter's Limited, 10-11; Submarine, 221-226; Submarine Scrip, 2-2¼; West India and Panama, Limited, 2⅜-2⅝; Ditto, 6 per cent. First Preference, 8¼-9; Ditto, ditto, Second Preference, 8¼-8¾; Western and Brazilian, Limited, 4¾-5; Ditto, 6 per cent. Debentures "A," 98-101; Ditto, ditto, ditto, "B," 96-99; Western Union of U. S. 7 per cent, 1 Mortgage (Building) Bonds, 116-120; Ditto, 6 per cent. Sterling Bonds, 101-103; Telegraph Construction and Maintenance, Limited, 31¼-32¼; Ditto, 6 per cent. Bonds, 100-103; Ditto, Second Bonus Trust Certificates, 2⅝-3; India-Rubber and Gutta-Percha and Telegraph Works, Limited, 27-28.

Railway shareholders can hardly be congratulated upon their prospects. As we intimated a little time ago, some of the dividends promise to be less than last half-year, and several will, no doubt, remain stationary. But it is not the dividends we are thinking of; we are thinking of the general condition of the companies, of their capital outlay, and of their increasing working expenses. It is possible that the leading journal, which has lately devoted much attention to the consideration of the question, exaggerates the gloominess of the outlook; but that it is sufficiently gloomy must be obvious to all impartial critics. In brief, is it not sheer folly to blink at the certainty that, if the companies go on increasing their capital, adding to their expenditure, and not sensibly adding to their income, the time will arrive, all too quickly, when even small dividends will be things of the past?

The Great Northern Company is already in difficulties. In spite of the positive tone assumed by the directors in the address they have recently issued to the shareholders, no one but the directors themselves—and perhaps not the directors—can deny that the anonymous circular they hold up to reprobation is written in a tone of marked moderation, and is sincerely intended to promote the interests of the shareholders. We believe that both it and other criticisms on the position and prospects of the Great Northern Company, which have lately appeared in print, are far more likely to do good than harm. The shareholders of the Great Northern Company have undoubtedly cause for apprehensions, and the assumption of the directors that it is presumptuous to comment on their actions, or to question their judgment, is simply ridiculous. There never was a period when railway companies wanted looking after more than they do at this juncture.

Look again at the East London Railway Company. One begins to wonder whether it has been managed by men or by children. The statements made in the circular issued by Sir Edward Watkin on his acceptance of the chairmanship more than account for the disastrous position of the company. No less than £3,404,595—the original capital was £1,866,600—has been actually expended by the concern. Here are some of the items:—Discounts, £540,691; financial agents' charges and commission, £192,517; interest on shares and debenture stocks, £337,015; preliminary expenses, £101,832—nearly £40,000 of this went to "the promoters;"—law and parliamentary expenses, £57,518; engineering, £66,981; directors and auditors, £16,222. Baron Grant on various occasions received from the directors altogether the sum of £333,306 for issuing debentures and preference stock. We do not say that the East London Company is past all hope, but if Sir Edward Watkin succeeds in rescuing the property, if property it can be called, from ruin, he will indeed earn the eternal gratitude of the shareholders, and convince every one that his abilities have really been under-estimated. It appears that part of the line is not worked at all, and produces, says Sir Edward, thistles and weeds instead of traffic and dividends. The Company is in debt beyond its available capital and resources to the extent of £120,000, and until this money is raised nothing can be done by the new Board. We have on several occasions drawn attention to the East London Company; but matters have turned out far worse than we supposed they could be. A searching inquiry into the details of the expenditure seems desirable, though it may be no practical use to cry over spilt milk. Mr. Kershaw might well say at the meeting of the shareholders of the company the other day that he wondered the old directors should face them again. At the meeting in question it was practically decided that Sir Edward Watkin, having the confidence of the shareholders, should be allowed to do what seemeth him best, and, to the surprise of some, it transpired that even some of the shareholders were willing to invest more of their money in the undertaking. Let us hope that their reward will be proportionate to their faith.

TRAFFIC RECEIPTS.

Name of Co., with amount of issued capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £1,300,000.	Cuba Sub. Co. £160,000.	Direct Spanish Co. £116,379.	Direct U.S. Co. £1,102,420.	Eastern Co. £3,697,000.	Eastern Ex. Co. £1,937,500.	Gt. Northern Co. £1,500,000.	Indo-Euro. Co. £425,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £1,398,200	West India Co. £983,210.
	£ a	£	£	£	£ b	£	£	£	£	£	£ c	£ x	£
June, 1878 ...	41,480	11,124	300	793	12,840	31,118	23,269	18,582	... ...	10,350	... ...	... ...	4,905
June, 1877 ...	40,040	9,843	3,295	873	15,260	45,477	24,126	19,663	... ...	9,960	4,025 x 2,225	20,522	5,541
†Total Inc. 1878	75,640	1,393	... ...	... ...	... ...	... ...	... ...	3,438	... ...	1,139	... ...	... ...	... ...
†Total Dec., 1878	... ...	... ...	881	666	6,370	26,327	3,718	... ...	... ...	... ...	... ...	... ...	2,147

a Amount accruing by arrangement with Direct Co. *c* Amount subject to arrangement with Anglo Co. † Compared with same period (six months) 1877. *x* June Receipts not yet to hand. *c* The May receipts of this Company amounted to £1,450.

(The figures in this Table are as accurate as it is in our power to make them, but we do not guarantee their correctness).